ASPEN ECONOMIC STRATEGY GROUP

aspen institute

EXECUTIVE SUMMARY

Technological Disruption in the US Labor Market

by David Deming, Christopher Ong, and Lawrence H. Summers

NOVEMBER 2024

Introduction

Deming, Ong, and Summers consider the effect of past episodes of technological disruption on the US labor market to draw lessons about the potential labor-market impacts of artificial intelligence (AI). Analyzing over a century of data, they document that the pace of change in the structure of the US labor market has slowed over time. This decline reflects the fact that past changes were more profound than recent ones. Periods of dramatic change were fueled by the introduction of general-purpose technologies (GPTs) like steam power and electricity. AI likely could be a GPT on the scale of prior disruptive innovations, with widespread and long-lasting impacts. But as the evidence on past disruptions shows, technology adoption and the pace of labor market change are often gradual, and it is likely too early to assess the full impacts of AI. The authors then study recent changes in the occupational structure of the US labor market, finding early signs of technological disruption associated with recent AI advances.

Labor Market Volatility over the Last Century

Deming, Ong, and Summers first measure technological disruption in the US labor market by looking at the relative frequencies of occupations from 1880 to 2020. Over that period, the structure of the US labor market underwent two large shifts:

1. From 1880 to 1960, workers moved out of agriculture. In 1880, 41 percent of all workers in the US economy were employed as farmers or farm laborers. This share fell consistently by 4 percentage points per decade, and by 1960 only 6 percent of US employment was in agriculture.

2. From 1960 to 1980, jobs moved from factories to offices. The share of workers employed in blue-collar jobs like manual labor, construction, production and manufacturing, transportation, and maintenance and repair remained relatively constant at 40 percent from 1880 to 1960, then fell ten percentage points by 1980. It has experienced a slower decline since, reaching 20 percent by 2010.

These shifts were brought about by the introduction of GPTs, which are conventionally considered technologies widely used, capable of ongoing improvement, and enabling complementary innovation across many different applications. Steam power and electricity enabled the mechanization of farm work and the rise of manufacturing. The

encoding and storing of digital information led to computerization of the labor market and the rise of clerical, office, and administrative-support occupations.
The authors draw two conclusions from these major disruptive episodes:

1. **Even though technological breakthroughs often occur rapidly, technology gets adopted gradually, and the disruption of labor markets takes decades.**

   The historical evidence on GPT adoption suggests that productivity growth follows a-J curve, where growth is initially sluggish because new complementary investments are required. For example, steam-powered machines were invented in the early 1800s, but it was not until the 1860s that farmers began to mechanize agricultural work using steam engines. Adoption of this new technology took place slowly over the next several decades, generating the large decline in farm work seen from 1880 through the middle of the twentieth century.

2. **The productivity growth enabled by GPTs leads to the creation of new occupation categories and makes other occupations more productive.**

   Technology substitutes for human labor through automation, but it also complements labor by making existing workers more productive and by changing their capabilities in ways that create new types of work. This dynamic has played out during each major shift in the labor market's structure. Mechanization destroyed farming jobs, but it also created factory jobs by increasing labor productivity in manufacturing. Similarly, computer-based manufacturing techniques developed in the 1970s replaced precision production jobs while also increasing the availability of digital data and the value of analytical and managerial skills. In fact, in both relative and absolute terms, the growth in professional occupations has fully offset the decline of blue-collar work in the US since 1970.

Using a newly constructed measure of occupational churn in the labor market, the authors find that the pace of labor market disruption has slowed in recent decades: the years spanning 1990 to 2017 were the most stable period in the history of the US labor market. The transition from agriculture to industry from 1880 to 1900, during which earlier advances in mechanization were being widely adopted in agriculture, was more disruptive than any decade during the computer and digital era. The three-decade period from 1940 to 1970, however, was the most volatile period in the history of the US labor market. During this time, agricultural employment was still disappearing, manual labor was shifting into production and away from railroads, and clerical and administrative work were growing rapidly.

Is AI a GPT?

While the labor market has changed relatively slowly over the past 30 years, the pace could quicken if AI fits the mold of past GPTs. The impact of AI is likely to be widespread, along the lines of prior GPTs, given its capacity to augment human decision-making and increase worker productivity. AI and ML technologies differ from standard programming techniques in that they can infer patterns from data, effectively "learning" about the world by studying and copying the actions of others. In this way, AI is best understood as a *prediction technology* that augments human decision-making. Since most jobs involve prediction and decision-making, AI can potentially replace tasks across low-, medium-, and high-paying jobs.

The net impact of AI on employment will depend on the balance between the replacement of existing job tasks and the impact of productivity gains from automation on the total demand for labor in a sector. This effect will likely vary by sector. For instance, AI adoption might lead to fewer jobs in the retail sector but have no impact on the number of jobs in the healthcare or education sectors, depending on how productivity gains change the overall consumption of the good or service in the impacted sector.

Early Warning Signs of AI-Related Disruptions

The authors suggest that two patterns in the data might indicate that AI is leading to labor market disruptions along the lines of past GPTs: first, increased investment in new technologies and a J-curve of productivity growth in AI-exposed sectors, and second, large but steady declines in employment share for AI-exposed jobs, especially jobs in sectors where consumers don't increase consumption with rising income. The authors present early evidence of such signs across four stylized facts:

1. **Job polarization has been replaced by general skill upgrading.** Job polarization—meaning employment growth at the bottom and top of the wage distribution and declines in the middle—occurred in the US labor market from 2000 to 2016, but employment growth since 2016 looks more like skill upgrading than polarization.

2. **Employment growth has stalled in low-paid service jobs.** The first decade of the 2000s was characterized by rapid growth in service sector jobs, including food preparation and service, cleaning, and health. However, the growth of service jobs stalled in the early 2010s and was flat for most of the rest of the decade. This decline had less to do with automation than with rising wages for lower-paid work and increased labor market tightness, though rising labor costs could spur automation at the lower end of the job market (as with self-service checkout).

3. **The share of employment in STEM jobs has increased by more than 50 percent since 2010, fueled by growth in software and computer-related occupations.** STEM employment is increasing rapidly after having declined in the first decade of the 2000s. The share of all employment in STEM grew from 6.5 percent in 2010 to nearly 10 percent in 2024. Increased employment in STEM occupations is also matched by increased capital investment in AI-related technologies. In recent years, investment in software and information processing has reached its highest share of GDP since 2001, largely driven by the increased computing power necessary to train frontier AI models. This increased investment in physical capital and technically skilled human capital may be a sign of future productivity growth, consistent with the J-curve hypothesis.

4. **Retail sales employment has declined by 25 percent in the last decade, likely because of technological improvements in online retail.** While it is too early to see any direct impact of ChatGPT or other LLMs on the labor market, the retail sector can provide a case study of the effects of related technologies. Online retail was an early adopter of predictive AI tools that generate personal recommendations (and prices) based on customers' browsing and buying histories and that forecast local product needs and stock warehouses accordingly. Between 2013 and 2023, retail sales declined by 850,000 jobs while labor productivity in the industry surged. This pattern of rapidly declining employment and fast labor-productivity growth is very similar to what occurred with production jobs in manufacturing half a century ago.

The Return of Churn in the US Labor Market

Each of these four patterns suggests that the pace of labor market disruption has accelerated in the past few years, as more recent data on occupational churn bears out. Recalculating their measure of labor market churn to include post-pandemic years, the authors find that labor market churn has been greater than that during any period since the 1970s. This fact suggests that the post-COVID labor market has been especially volatile by historical standards.

AI's Role in the Skill Upgrading of White-Collar Work

The authors conclude by predicting that AI will contribute to the ongoing decline in back-office administrative jobs and a rise in management and business operations occupations. AI tools such as personalized pricing algorithms and automated scheduling raise productivity by smoothing the transmission of information within firms and between firms and the labor market. As AI technology improves, these innovations may lead to declining employment in sales and administrative-support occupations.

With respect to professional and managerial workers, it is likely that AI tools will commodify certain tasks, such as writing business plans, generating article headlines, and writing or translating software code. The remaining tasks—analysis, decision-making, and adjudicating between the conflicting perspectives and desires of co-workers—are likely to become highly valuable as a result. While AI certainly helps with these tasks, the demand for good ideas and cogent analysis of complex counterfactual thought experiments may be nearly unlimited. In this way, at least in the near term, AI is more likely to ratchet up firms' expectations of knowledge workers than it is to replace them.

ABOUT THE AUTHORS

David Deming

Isabelle and Scott Black Professor of Political Economy, Harvard Kennedy School

David Deming is the Isabelle and Scott Black Professor of Political Economy at the Harvard Kennedy School (HKS) and the faculty dean of Kirkland House at Harvard College. He also served as Academic Dean of HKS from 2021 to 2024. Deming is an economist whose research focuses on higher education, economic inequality, skills, technology, and the future of the labor market. He is a Principal Investigator (along with Raj Chetty and John Friedman) at the CLIMB Initiative, an organization that seeks to study and improve the role of higher education in social mobility. He also leads the Project on Workforce, a cross-Harvard initiative on the future of work. He is co-founder of the Harvard Skills Lab, an organization that creates and tests science-backed measures of "soft" skills like teamwork and decision-making. In 2018, he was awarded the David N. Kershaw Prize for distinguished contributions to the field of public policy and management under the age of 40. In 2022, he won the Sherwin Rosen Prize for outstanding contributions to labor economics. His writing appears in The Atlantic and The New York Times as well as on his Substack newsletter, *Forked Lightning*.

Christopher Ong

Predoctoral Fellow, Harvard University

Christopher Ong is a predoctoral fellow at the Mossavar-Rahmani Center for Business and Government at Harvard Kennedy School. His research explores the intersections of globalization, technological innovation, and economic policy. Previously, he contributed to the Harvard School of Engineering and Applied Sciences within the Teamcore group, where he focused on developing AI applications for social impact. He

also worked as a software engineering intern at Microsoft. He holds a bachelor's degree in computer science from Harvard University.

Lawrence H. Summers

Charles W. Eliot University Professor and President Emeritus, Harvard University

Lawrence H. Summers is the Charles W. Eliot University Professor and President Emeritus of Harvard University. During the past three decades, he has served in a series of senior policy positions in Washington, D.C., including the 71st Secretary of the Treasury for President Clinton, Director of the National Economic Council for President Obama and Vice President of Development Economics and Chief Economist of the World Bank. He received a Bachelor of Science degree from the Massachusetts Institute of Technology in 1975 and was awarded a Ph.D. from Harvard in 1982. In 1983, he became one of the youngest individuals in recent history to be named as a tenured member of the Harvard University faculty. In 1987, Mr. Summers became the first social scientist ever to receive the annual Alan T. Waterman Award of the National Science Foundation (NSF), and in 1993 he was awarded the John Bates Clark Medal, given every two years to the outstanding American economist under the age of 40. He is currently the Charles W. Eliot University Professor at Harvard University and the Weil Director of the Mossavar-Rahmani Center for Business & Government at Harvard's Kennedy School. He and his wife Elisa New, Host and Director of PBS's Poetry in America, reside in Brookline and have six children.

About the Aspen Economic Strategy Group

The Aspen Economic Strategy Group (AESG), a program of the Aspen Institute, is composed of a diverse, bipartisan group of distinguished leaders and thinkers with the goal of promoting evidence- based solutions to significant U.S. economic challenges. Co-chaired by Henry M. Paulson, Jr. and Timothy F. Geithner, the AESG fosters the exchange of economic policy ideas and seeks to clarify the lines of debate on emerging economic issues while promoting bipartisan relationship-building among current and future generations of policy leaders in Washington.